School of Mathematical and Computational Sciences

Indian Association for the Cultivation of Science

Master's/Integrated Master's-PhD Program/ Integrated Bachelor's-Master's Program/PhD Course

Theory of Computation II: COM 5108

Quiz I (20 August 2025)

Answer All Questions

Marks: 10

1. Answer with a brief justification (no formal proof is required). **[5]**

   (a) Is the set $\{0,1\}^*$ countably infinite?

   (b) Is the collection of all regular languages over $\{0,1\}^*$ *uncountable*?

   (c) Is the collection of *context-free languages (CFL(* over $\{0,1\}^*$ closed under complementation?

   (d) Is the collection of *decidable/recursive* languages over $\{0,1\}^*$ closed under complementation?

   (e) Is the collection of all *semi-decidable/recursively-enumerable* languages over $\{0,1\}^*$ closed under intersection?

2. Give a bijection from $\mathbb{N}_0 \times \mathbb{N}_0 \times \mathbb{N}_0 \to \mathbb{N}_0$. **[2]**

3. Prove using *mapping reducibility* that $L_{CFL} = \{< M >:\ M$ is a Turing machine and $L(M)$ is a CFL$\}$ is undecidable. **[3]**